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## A Tumorlike Papilliform Growth in the Brown Shrimp (*Penaeus aztecus*)<sup>1</sup>

ALBERT K. SPARKS AND DONALD V. LIGHTNER

*U.S. Department of Commerce,  
National Oceanic and Atmospheric Administration,  
National Marine Fisheries Service Gulf Coastal Fisheries Center,  
Galveston Laboratory, Galveston, Texas 77550*

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A brown shrimp, *Penaeus aztecus*, from an experimental pond of the Texas Parks and Wildlife Department's Marine Laboratory at Palacios, Texas, possessed a papilliform tumorlike growth on the right ventrolateral aspect of the sixth abdominal segment. Gross and histological study revealed the lesion to be confluent with the carapace, epidermis, and subepidermal connective tissue. The growth, tentatively diagnosed as a benign neoplasm, consists of grossly hypertrophied and normal tissue elements.

### INTRODUCTION

The occurrence of tumors and tumorlike growths in invertebrates has been comprehensively reviewed (Scharrer and Lockhead, 1950; Sparks, 1969, 1972). Although common in insects, especially the fruitfly *Drosophila*, neoplasms in other arthropods are extremely rare on the basis of the paucity of reports (Sparks, 1972). Of the eight papers concerned with tumors or tumorlike growths in noninsect arthropods, several are of dubious validity or are only briefly mentioned in articles primarily concerned with other information.

Hanström (1926) described a chitinous body near the anterior end of the brain in the primitive arthropod *Limulus*. It resembled "dermoid" cysts of mammals in that it was formed by recession of a saclike portion of the ectoderm within the body, where it continued to secrete successive chitin layers.

Several abnormalities of the integument

of ticks that could be considered a form of neoplasia have been reported. Olenov and Rozhdestvenskaja (1933) found four female ticks, *Hyalomma* sp. and *Dermacentor niveus*, in a collection from Turkestan whose bodies were covered with numerous, up to 1000, oval, whitish, well defined glossy surfaces. These papules were equally distributed on the dorsal and ventral surfaces but were confined to the more thinly chitinized parts of the body, thus being absent from the capitulum, scutum, and legs. Sections revealed that the papules were composed of chitin, but the cause and significance could not be determined. Subsequently, Colas-Belcour (1937) described similar lesions of the integument of two female ticks of the genus *Hyalomma*. The author believed the growths resulted from an infection, but was unable to demonstrate microorganisms in fixed material.

In the Crustacea, tumors have been reported in lobsters, a shrimp, and a crab. Herrick (1895, 1909) briefly described a large growth on the side of a lobster, *Homarus americanus*, from Vineyard Sound, Massachusetts. The lesion consisted

<sup>1</sup>Contribution No. 356, National Marine Fisheries Service, Gulf Coastal Fisheries Center, Galveston Laboratory, Galveston, Texas 77550.

of a craterlike depression covered by a thin membrane. The author thought the growth was a "sore" resulting from a wound (inflammatory response). Rathbun (1884) reported a similar case, and Prince (1897) described a tumorlike growth that originated in the wall of the stomach sac of a large lobster and perforated the carapace and caused its death. Unfortunately, no illustrations were provided for any of these lesions.

Savant and Kerwalramani (1964), in recording a new host record for an isopod parasite, *Bopyrus squillarium*, stated that the parasite caused a 7-mm tumor in the left branchial chamber of the host, *Palaemon tenuipes*. Since it is inconceivable that the authors believed the swelling of the carapace caused by the parasite represented neoplasia, we assume they used the term tumor in its broadest sense, i.e., swelling.

Fischer (1928) stated that he found tissue resembling "cancer" in the abdomen of a crab, *Carcinus maenus*, parasitized by *Sacculina carcinae*, and noted further that tissue resembling a vertebrate adenocarcinoma was present in the eye of the crab. However, the lack of photomicrographs or detailed description of the presumed neoplastic tissue leaves the veracity of this reported neoplasm suspect.

A brown shrimp, *Penaeus aztecus*, with a papilliform growth on its abdomen was recovered from an earthen pond of the Texas Parks and Wildlife Department's Marine Laboratory at Palacios, Texas, on June 13, 1972. It was from a population of shrimp spawned and grown to the postlarval stage at the Galveston Laboratory of the Gulf Coastal Fisheries Center and subsequently stocked on April 3, 1972, by Texas Parks and Wildlife in an experimental pond.

#### MATERIALS AND METHODS

Because fixative solution was unavailable, the shrimp was frozen in preparation for transport to the Galveston Laboratory.

On arrival the specimen was thawed and fixed in 10% formalin buffered with sodium acetate. After fixation, the growth was bisected and the posterior half embedded, serially sectioned, and stained with hematoxylin and eosin and periodic acid-Schiff stains using routine histological techniques.

#### RESULTS

##### *Gross Observations*

The tumorlike growth (Fig. 1) arose from the right ventrolateral aspect of the sixth abdominal segment. It was 8 by 8 by 9 mm high, was cauliflowerlike in appearance, and with numerous papilliform projections at its apical end. The proximal portions were smooth and covered with a tough, but somewhat pliable, surface. In the fixed state, the basal portion externally was of the same color as the adjacent exoskeleton, while the apical portions were distinctly darker.

On cut section (Fig. 2), the growth appeared to originate from and to be continuous with the epidermis and subepidermal tissues. There was, however, a distinct separation of the base of the growth from the underlying muscle tissue of the adjacent abdomen. The cut section further revealed that the lesion was covered with a chitinous layer overlying a layer of darkly pigmented tissue and contained a relatively soft, amorphous amber core.

Marked deformation or atrophy of the cuticle was apparent posterior to the lesion (Fig. 1). The surface of the cuticle was somewhat roughened, and the uropods and telson were much smaller than normal and abnormal in appearance.

##### *Histological Observations*

Microscopical study of the stalk of the tumor verified the gross observation of the continuity of the epidermis from the adjacent normal body tissue into the tumor (Fig. 3). However, the epidermis is markedly hypertrophic and hyperchromatic in the stalk (Fig. 4), over the core, and espe-

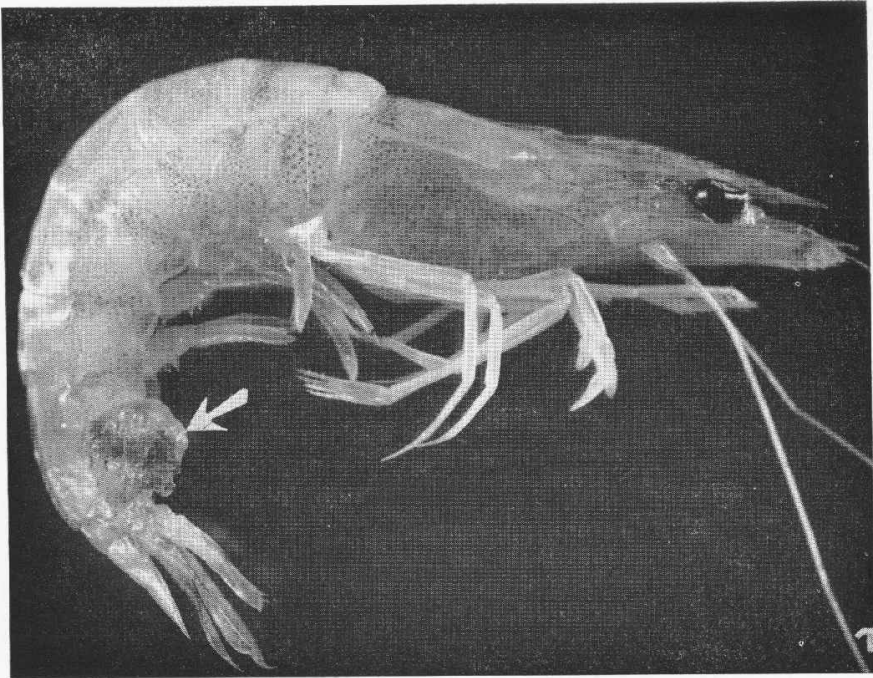


FIG. 1. Brown shrimp (*Penaeus aztecus*) bearing a papilliform growth (arrow) on the sixth segment of the abdomen. Note the abnormal uropods and telson posterior to the lesion.

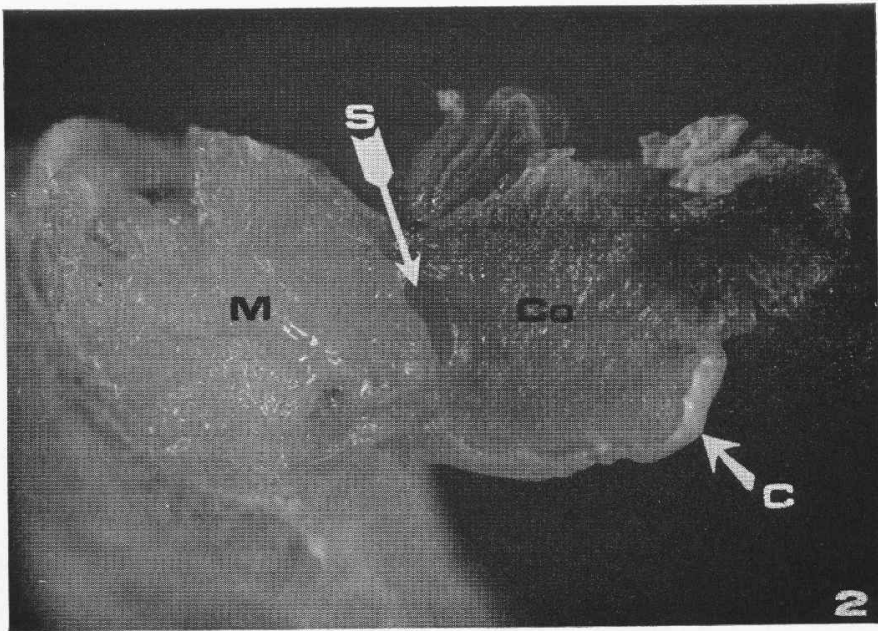


FIG. 2. Gross appearance of the lesion and adjacent normal body on cut section. Note the space (S) between the abdominal musculature (M) and the core (Co) of the growth. Also note the thickened cuticle (C) covering the growth.





FIG. 3. Section through the stalk of the growth. The tumor is to the right and the shrimp abdomen proper is to the left. Hematoxylin and eosin staining.  $\times 140$ .

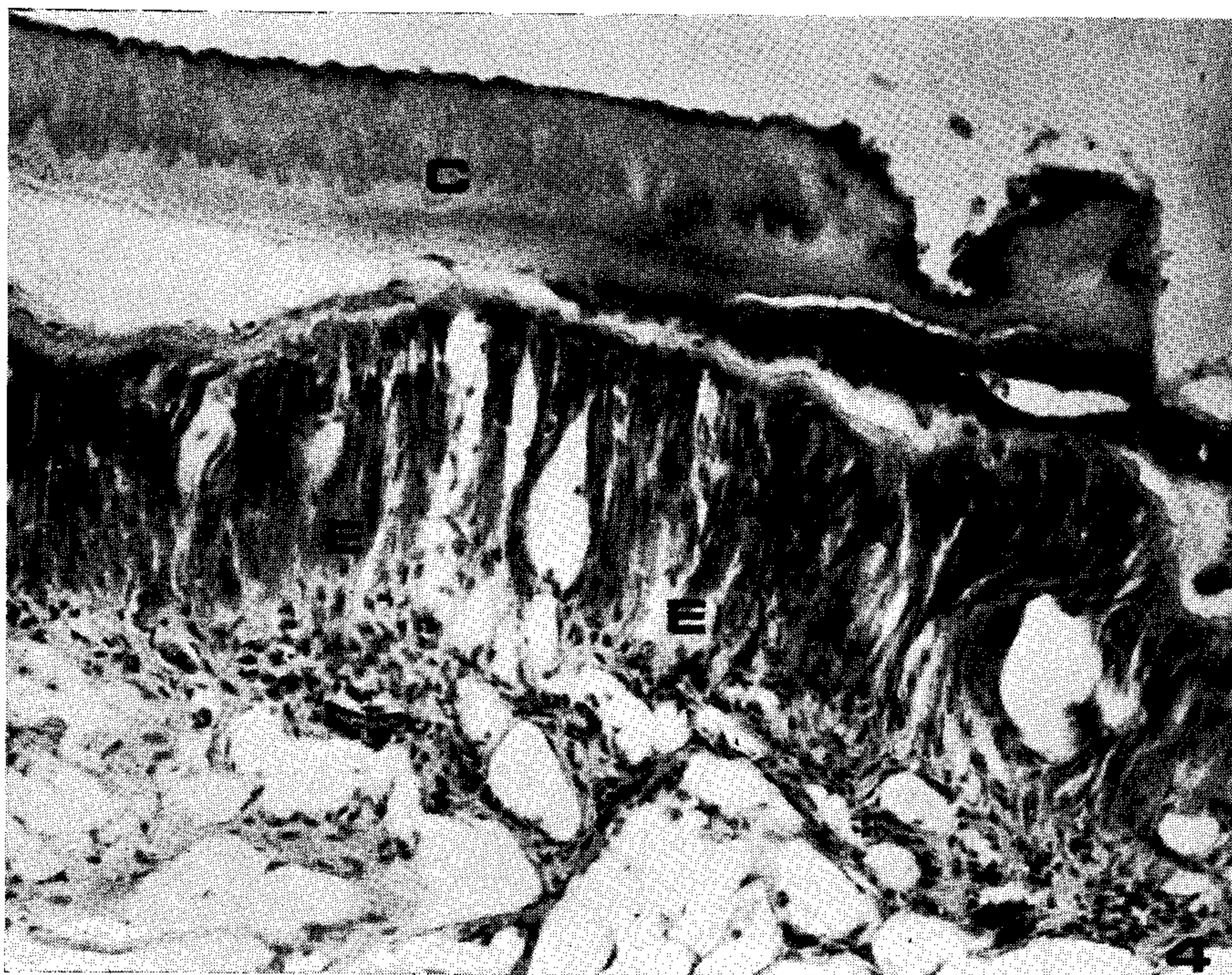


FIG. 4. A higher magnification of the tumor stalk. Note the hypertrophic and hyperchromatic epidermis (E) and the thickened cuticle (C). Hematoxylin and eosin staining.  $\times 190$ .



cially in the apical projections (Fig. 5) and lateral convolutions (Fig. 6). The cuticle covering the tumor is continuous from the normal body over the growth (Figs. 3-6), including the numerous fingerlike projections at the apex. However, the portion of the cuticle covering the lesion is abnormal in that it is greatly thickened and stains



FIG. 5. Micrograph showing the apical folds of the epidermis and cuticle. Hematoxylin and eosin staining.  $\times 35$ .



FIG. 6. Lateral folds or convolutions of the lesion. Hematoxylin and eosin staining.  $\times 175$ .



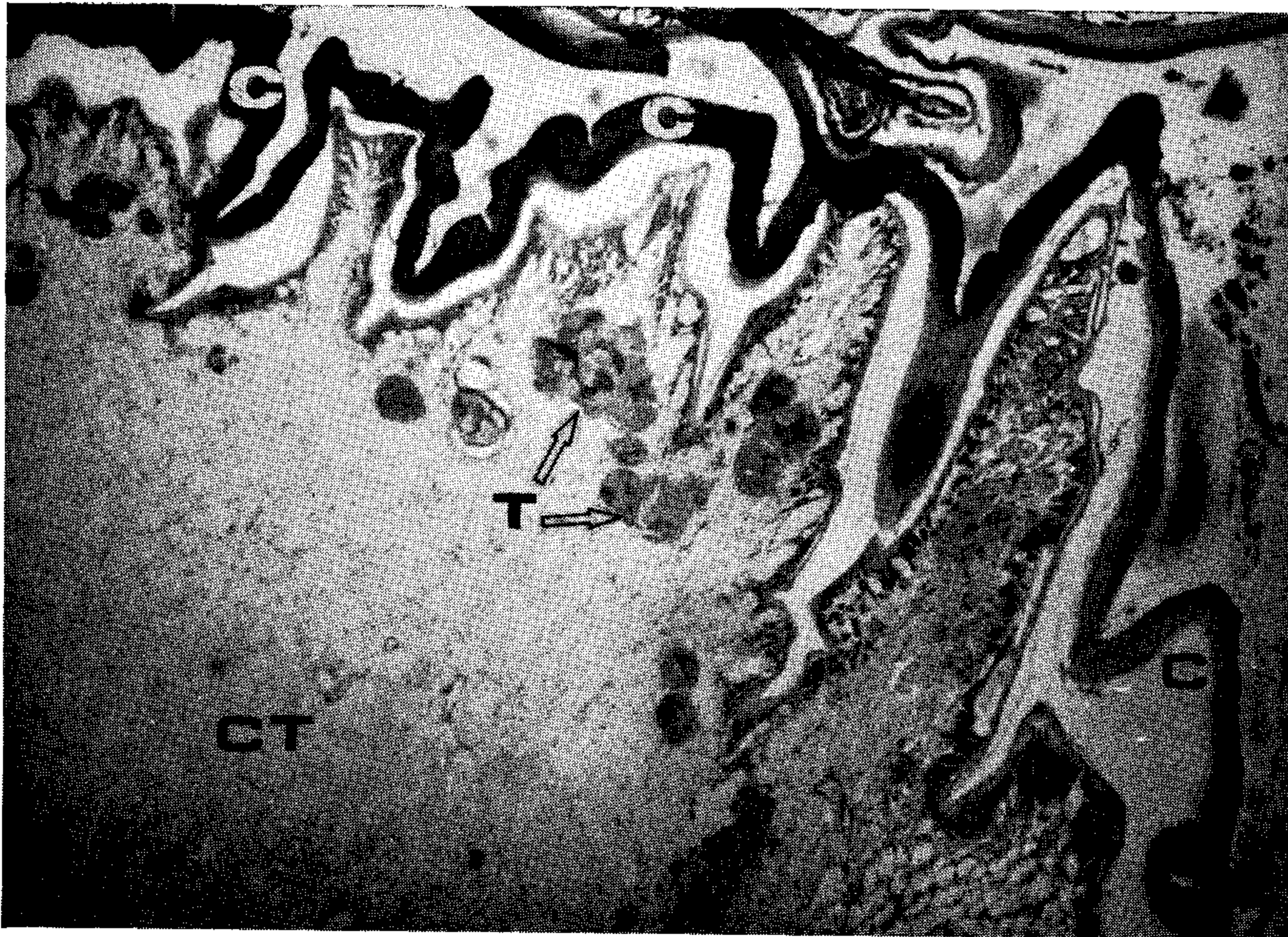


FIG. 7. Micrograph showing a portion of the tumor near the apical end. The core (CT) of the tumor is composed of a loose vacuolated connective tissue stroma and contains numerous tegumental glands (T) basal to the epidermis and cuticle (C). Hematoxylin and eosin staining.  $\times 35$ .



FIG. 8. Tegumental glands (T) in the loose connective tissue stroma basal to the epidermis. Hematoxylin and eosin staining.  $\times 150$ .



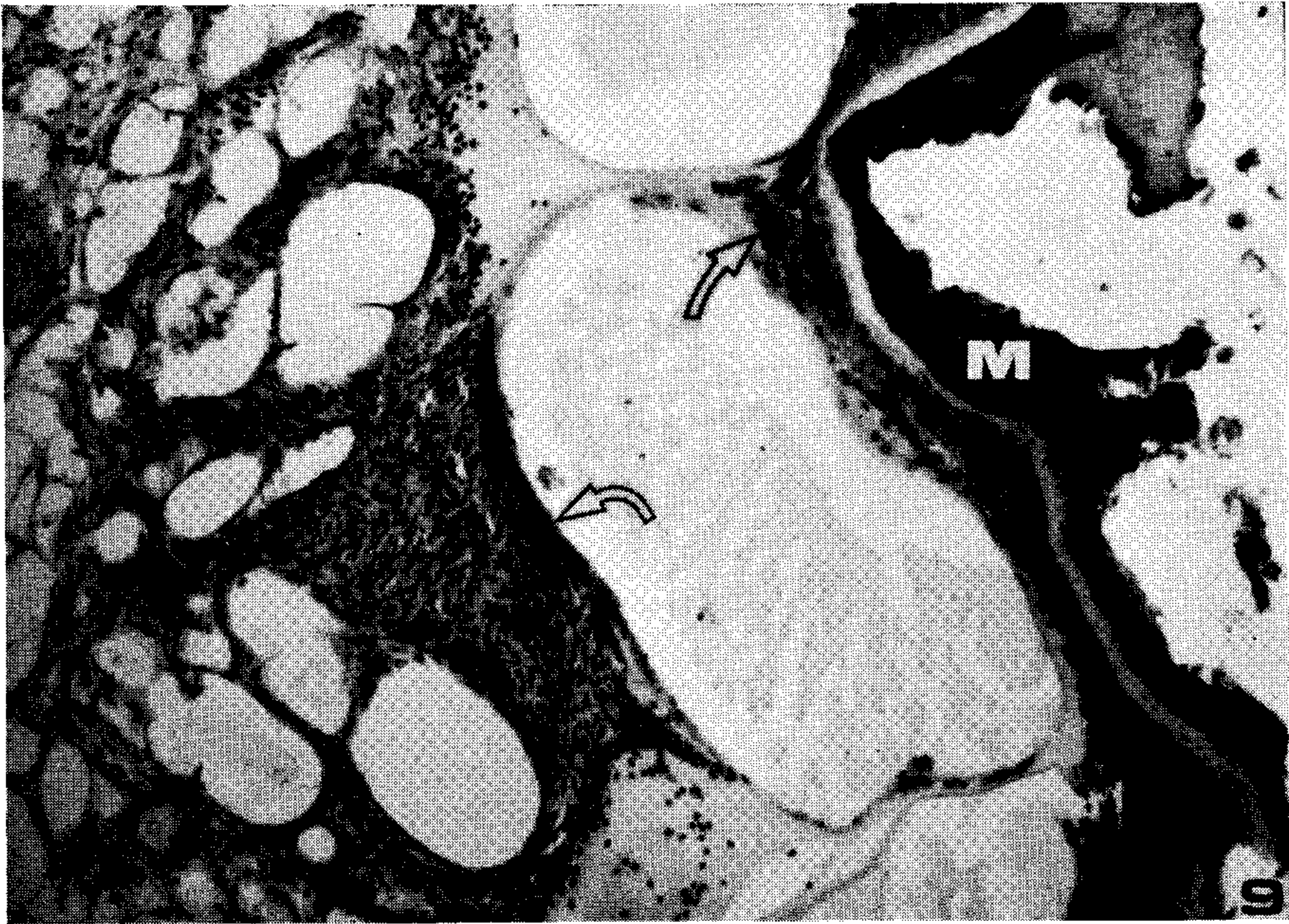


FIG. 9. A traumatized area showing a rather intense inflammatory response near the surface of the tumor. Note the numerous hemocytes (arrows), dark melanized areas (M), and edematous swellings. Hematoxylin and eosin staining.  $\times 150$ .

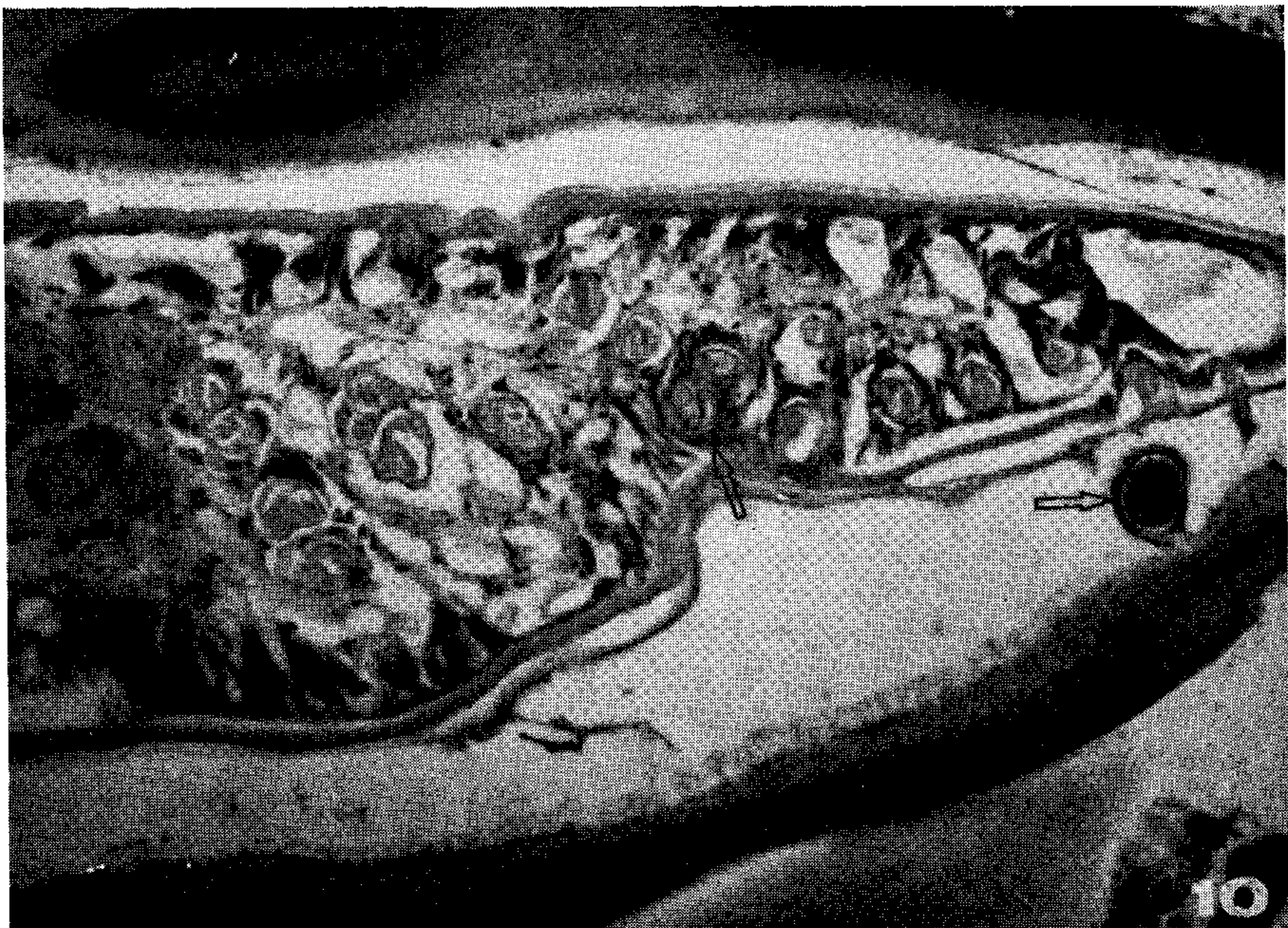


FIG. 10. Micrograph of the bases of setae (arrows) in the subepithelial connective tissue and near the cuticle of the tumor stalk. Hematoxylin and eosin staining.  $\times 150$ .



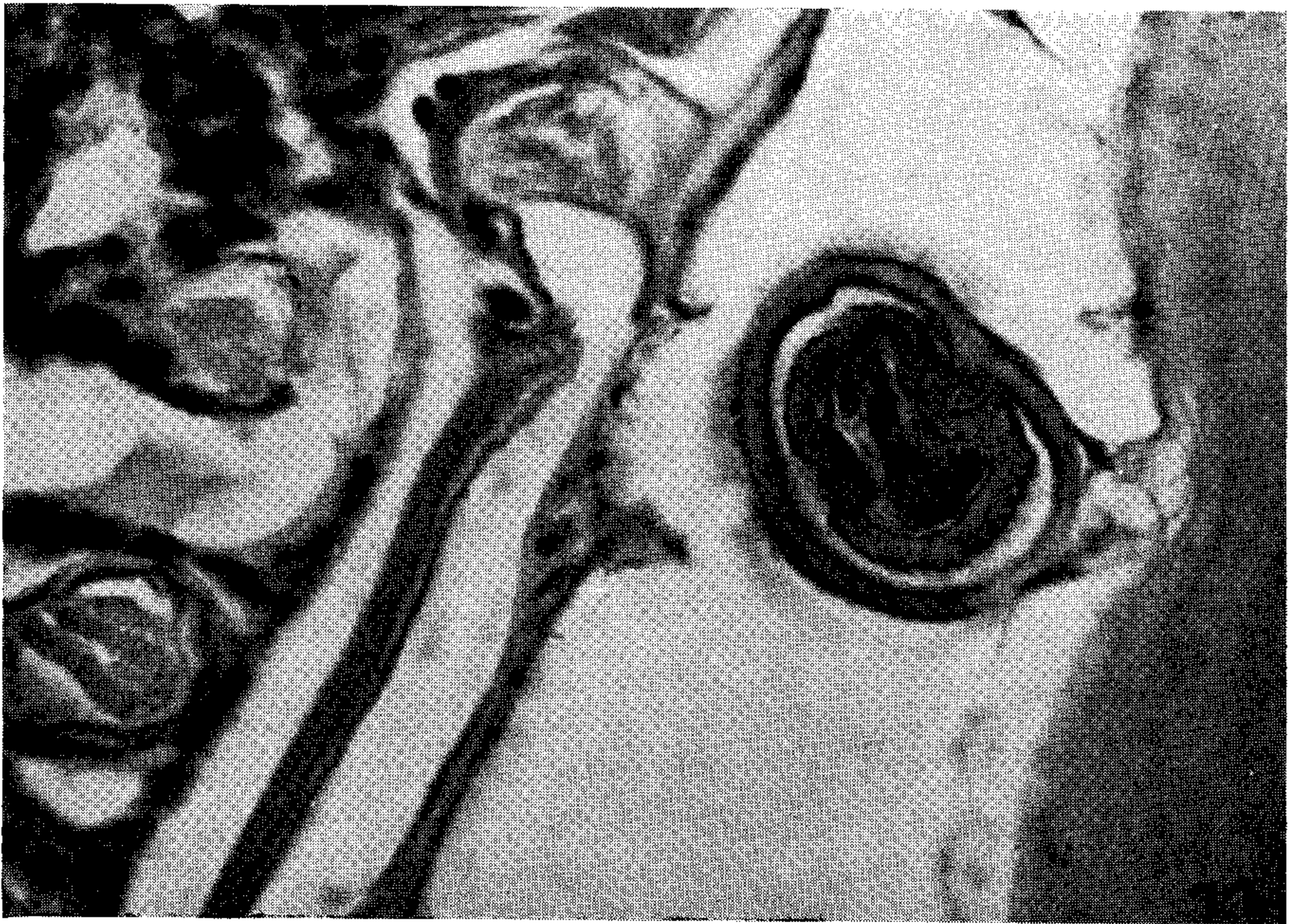


FIG. 11. A higher magnification of the bases of setae within the tumor base. Without careful study, the setae may be confused as encysted parasites.  $\times 600$ .

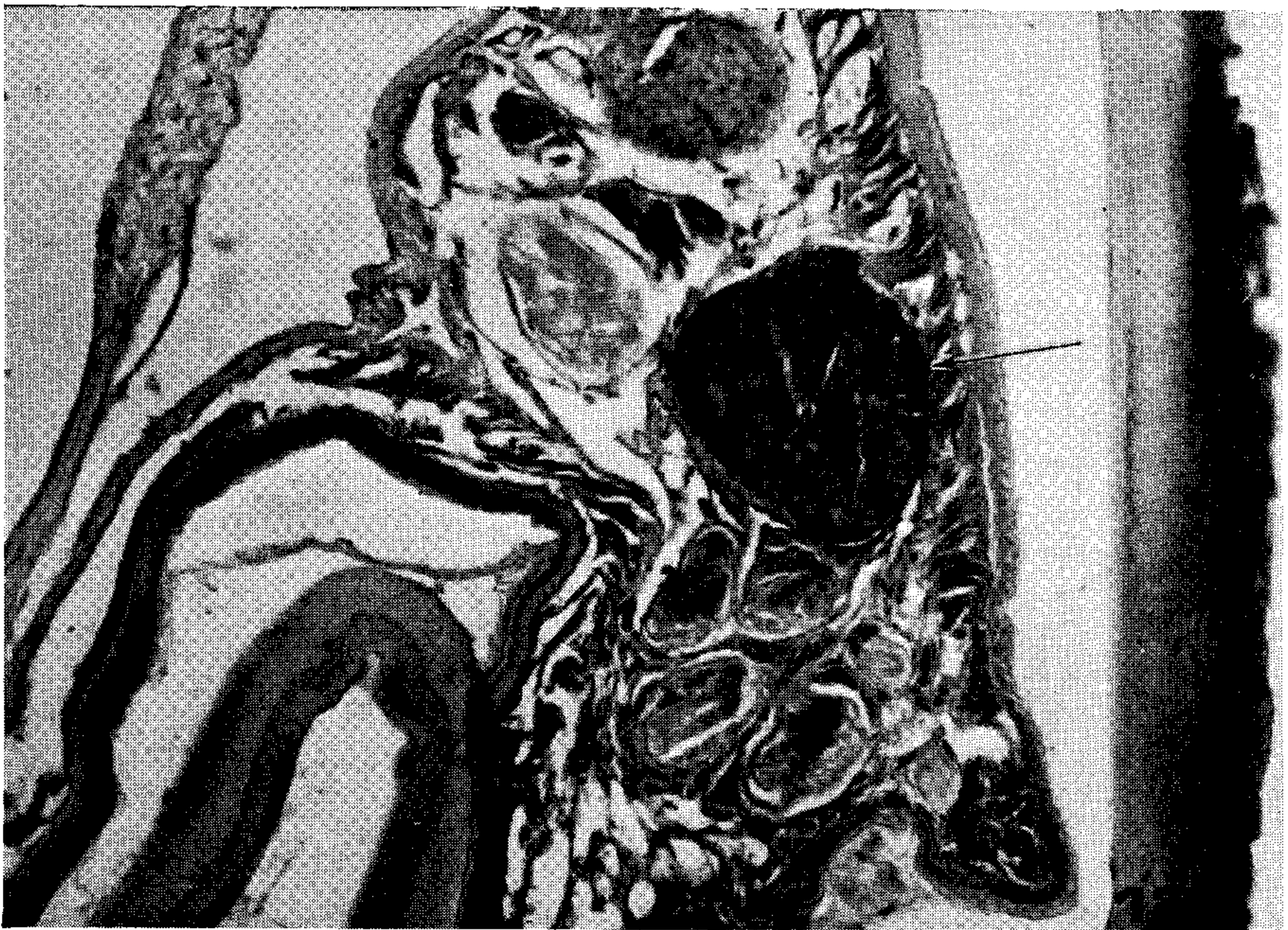


FIG. 12. Setae bases in a cuticular fold on the left ventrolateral aspect of the sixth abdominal segment (opposite the tumor). One of the seta pits (arrow) is congested with hemocytes. Hematoxylin and eosin staining.  $\times 220$ .



much more intensely basophilic than normal cuticle, which is perhaps attributable to the hypertrophic condition of the epidermis.

The loose vacuolated connective tissue core of the tumor is continuous with the connective tissue overlying the abdominal musculature. It is, however, greatly expanded in volume, is well vascularized, and may contain some scattered muscle fibers. Tegumental glands (Dennell, p. 455, in Waterman, 1960) are common in the growth but are abnormal in several ways. They are more numerous than normal in some areas (Fig. 7) and completely lacking in others. Also, they may be abnormal in location, some being fairly deep into the core, far removed from their normal location just beneath the epidermis (Fig. 8).

As might be expected, some peripheral areas of the tumor were traumatized (Fig. 9), with edema beneath the epidermis and a rather intense inflammatory response.

The most enigmatic aspect of the lesion was the presence of what appeared to be encysted organisms in the tumor base (Figs. 10, 11). Twenty of these structures measured between 35 and 45  $\mu\text{m}$  in diameter. After examination of the structures in serial section in the tumor base and observation of identical structures at the same location in normal shrimp, it was determined that the structures are the bases of cuticular setae rather than encysted parasites. Apparently, the tumor grew around and enclosed the setae, thus accounting for their presence deep within the tumor base. Setae identical in appearance to those in the tumor base are present in the cuticular fold on the left side of the shrimp (Fig. 12).

#### DISCUSSION

There are several aspects of this growth that warrant discussion. The question, of course, is whether the lesion is truly neoplastic or simply represents an unusual, if not unique in shrimp, case of hyperplasia. All tissues present in the lesion are normal constituents of the cuticle, epidermis, and

underlying connective tissue. The tissues are highly modified; however, beginning with the marked hypertrophy of the epidermis. Furthermore, there are no extensive areas of connective tissue present in the normal shrimp that resemble the core of the lesion. Finally, the folds along the sides and the fingerlike projections at the apex are so atypical of the normal body covering that one can hardly evade the conclusion that the lesion consists of tissue that is no longer controlled by the growth regulating processes of the shrimp.

There is, however, one important point that mitigates against a diagnosis of neoplasia. Despite careful examination, no mitotic figures were found. Normal cell division in decapod crustaceans, other than in the developing ova and sperm, is restricted to a short period before ecdysis (Passano, p. 145, in Waterman, 1960). It appears that time of cell division in the lesion was still under the growth-regulating mechanisms of the shrimp, thus denying one of the cardinal characteristics of neoplasia, i.e., that growth is independent of the normal growth regulating mechanisms of the host. It may well be the case in crustaceans that even in neoplasia the hormonal control is sufficiently strong to exert control over mitosis in the lesion and that the uncontrolled and rapid growth is restricted to the normal period of mitotic activity. We, therefore, tentatively suggest that this, the first recorded tumorlike growth in a penaeid shrimp, is a benign neoplasm.

#### ACKNOWLEDGMENTS

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